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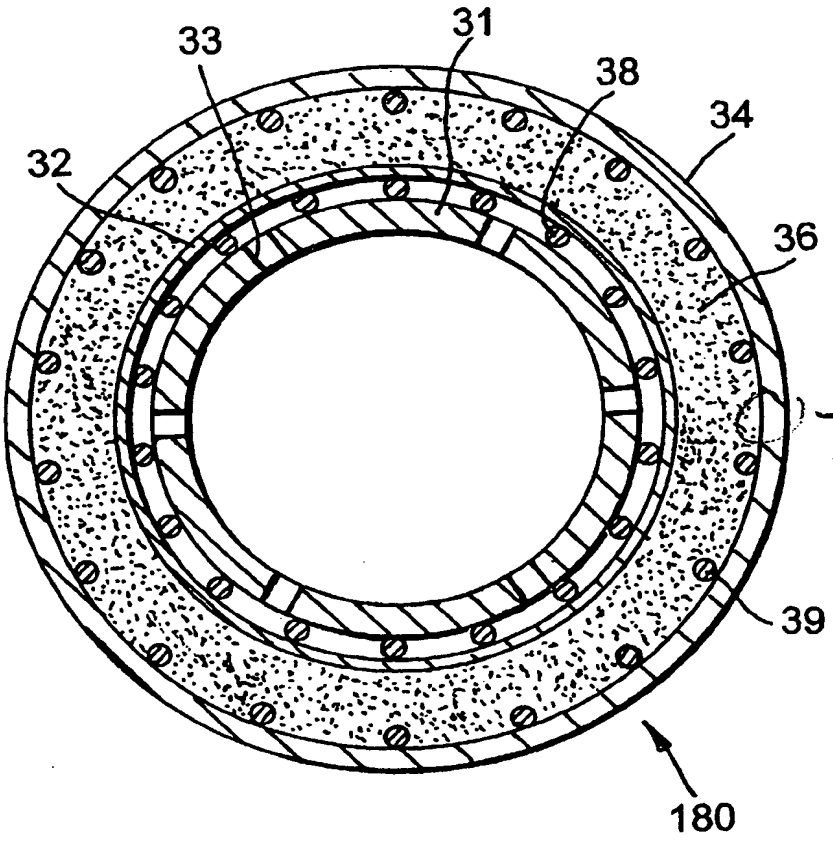
(54) Title: FILTER APPARATUS FOR USE IN WATER WELLS



(57) Abstract: The present invention generally provides a wellscreen for use in water wells. In one aspect of the invention, the wellscreen includes a perforated base pipe (31), an inner wrap (32) and an outer wrap (34) with a filter material (36) packed in an annular area therebetween. The filter material provides additional filtering of fluids passing therethrough and also makes the wellscreen more resistant to collapse.

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FILTER APPARATUS FOR USE IN WATER WELLS

This invention relates to filter apparatus for use in water wells to filter contaminants. More particularly, the invention relates to wellscreen for use in water wells.

Water wells are drilled to access water producing strata. As water is recovered, contaminants from the wellbore are also retrieved at the surface of the well. Because of their abrasive nature, contaminants can cause wear and tear on production tubing, pumps, valves and other equipment associated with producing water wells. Controlling and reducing the amount of contaminants reduces valuable time and expense associated with water wells.

In conventional methods, wellscreen is disposed on production tubing and positioned adjacent a production zone. Figure 1 is a sectional view showing a conventional wellscreen used in a water well. The water well 10 includes a well head 11 disposed at the top of a wellbore lined with casing 12. Production string 13 is disposed coaxially within the casing 12. Disposed at a lower end of production string 13 is a submersible pump 17 to pump the water to the surface, a wellscreen 18 to filter particulates and other contaminants, an electric motor 19 to drive the submersible pump 17 and a power line 21 extending from the surface of the well to provide electricity to the motor 19. Wellscreen 18 acts as a barrier to contaminants entering the production string 13 thereby protecting the submersible pump 17, and other production equipment. Wellscreens typically include a perforated base pipe with at least one layer of screen-like material wrapped therearound. An annulus 22 is formed between the wellscreen 18 and the casing 12. In Figure 1, the annulus 22 is shown with a gravel pack 43 therein. The gravel acts as a filter layer and in addition to the wellscreen, prevents contaminants from entering the production string 13.

There are some disadvantages with conventional wellscreens in water wells. Because the wellscreen alone is often inadequate to filter particles, a gravel pack is usually necessary to more effectively prevent the entry of particles into the production string. In order to effectively utilise a gravel pack, a wellbore's diameter must be large

enough to accommodate both a wellscreen and the required space to hold the gravel pack. Further, under reaming (digging below the lower end of a wellscreen to make room for gravel) is also required to utilise a conventional wellscreen with a gravel pack. Additionally, gravel pack operations do not always result in a completely filled annular area, thereby decreasing the effectiveness of the filtering of contaminants.

Conventional wellscreens used in water wells are also subject to failure and can collapse due to hydrostatic pressure. For example, water bearing strata may be formed at such depths below the surface that wellscreens are subjected to relatively large amounts of hydrostatic pressure. These pressures result in high stresses in a radial direction, which may cause the wellscreen to deform or collapse. Further, if one small area of the wellscreen is structurally compromised from damage during placement, a catastrophic failure of the wellscreen in use can result, thereby necessitating cost and time to replace the wellscreen.

There is a need therefore for a wellscreen for use in a water well that more effectively filters particles and other contaminants. There is a further need for a wellscreen for use in a water well that is more robust than conventional screens. There is a further need therefore, for a wellscreen for a water well that filters contaminants effectively without the need of a gravel pack.

The present invention generally provides a wellscreen for use in water wells. In one aspect of the invention, the wellscreen includes a perforated base pipe, an inner wrap and an outer wrap with a filter material packed in an annular area therebetween. The filter material provides additional filtering of fluids passing therethrough and also makes the wellscreen more resistant to collapse.

Further preferred features are set out in claims 2 *et seq*.

Some preferred embodiments of the invention will now be described by way of example only and with reference to the accompanying drawings, in which:

Figure 1 is a sectional view showing a conventional wellscreen in a water well; and

Figure 2 is a cross-sectional view of a wellscreen in accordance with the present invention.

Figure 2 is a cross-sectional view of one embodiment of the wellscreen of the present invention. A base pipe 31 has radially extending perforations 33 therethrough and a first set of rods 38 disposed longitudinally on the outer surface thereof. The first set of rods 38 separate the pipe 31 from an inner wrap 32. A filter material 36 is disposed between the inner wrap 32 and an outer wrap 34. In the preferred embodiment, a second set of rods 39 are attached longitudinally to the inner surface of the outer wrap 34 to provide structural support. The wraps 32, 34 may be constructed of any material that can be concentrically formed to allow the passage of the desired fluids into a production string, while remaining substantially impermeable to particulate matter. Example of material includes metal wire, sintered fibres, ceramic materials, woven polymer fabrics or Dutch twill weaves. While the base pipe 31 is perforated in the embodiment illustrated, the base pipe 31 may be slotted or may include perforations of any shape so long as the perforations therethrough permit the passage of production fluid but inhibit the passage of particles.

The filter material 36 between the wraps 32, 34 may include any material disposable in an annular area and capable of filtering contaminants from the production fluids. Filter material 36 includes a gravel pack, silica sand, stainless steel shots, plastic beads, ceramic beads, glass beads, any combination thereof or any similarly functioning material. Because the filter material 36 is pre-packed into the wellscreen 180, the uniformity of material causes it to be more effective as a filter. Although the current invention may be practised in conjunction with a gravel pack, the filter material 36 can eliminate the need and expense of a gravel pack around the exterior of the wellscreen. Because a gravel pack is not required, the diameter of a wellbore can be smaller to accommodate only a wellscreen with no additional annular space needed for a gravel pack.

In addition to the filtering function, the wellscreen 180 of the present invention is also more robust than conventional wellscreens because filter material 36 functions to re-distribute and generalise any localised stress. For example, when a localised, radial stress acts upon the outer wrap 34 of the wellscreen 180, the stress is distributed throughout the tightly and uniformly packed filter material 36, thereby reducing the effect of the stress on the inner wrap 32. Because the localised stresses are no longer focused, but are distributed throughout the wellscreen 180, the life of the wellscreen 180 is extended.

In order to measure collapse strength, pressure differential tests were conducted on a conventional wellscreen having a single wrap of screen-like material around a base pipe and the wellscreen of the present invention having two wraps with filtering material disposed therebetween. A typical test result is shown in Table 1.

Table 1-Test Results of Collapse Pressure of a Conventional Wellscreen and Filter Packed Wellscreen.

Wellscreen Outer Diameter of 6.625" (16.8 cm)	Collapse Pressure Differential
Conventional Wellscreen	186 p.s.i. (1.28 MPa)
Filter Packed Wellscreen	3,000 p.s.i. (20.7 MPa)

The tests were carried out as follows: The test wellscreen is placed in a pressure vessel. Plugging agents designed to simulate contaminants and prevent flow through the wellscreen are introduced into the pressure vessel. The plugging agents surround the wellscreen and the pressure differential is measured between the outside and the inside of the wellscreen to ensure flow into the wellscreen is completely blocked. Thereafter, additional pressure is applied to the outer surface of the wellscreen and is increased until the wellscreen collapses. The collapse pressure is recorded and the wellscreen is removed and inspected for damage.

Table 1 illustrates that a conventional wellscreen collapses at a pressure differential of 186 p.s.i. (1.28 MPa), while the wellscreen of the present invention having the characteristics and structures illustrated in Figure 2 collapses at a

significantly higher-pressure differential of 3,000 p.s.i. (20.7 MPa), or sixteen times the collapse pressure of a conventional wellscreen. The data illustrates that by using the wellscreen described herein, the wellscreen can withstand greater hydrostatic pressure than a conventional wellscreen, thereby decreasing costs and time associated with water well production.

It will be appreciated that variations from the above described embodiments will still fall within the scope of the invention.

CLAIMS:

1. A wellscreen for use in water wells, comprising:
a perforated base pipe;
an inner wrap disposed around said perforated base pipe;
an outer wrap disposed around said inner wrap; and
a filter material disposed between the inner and outer wraps.

2. A wellscreen as claimed in claim 1, whereby the filter material is selected from a group of gravel, sand, stainless steel shots, plastic beads, ceramic beads, glass beads, and a combination thereof.

3. A wellscreen as claimed in claim 1 or 2, wherein the wellscreen is placed in a wellbore on a production string.

4. A wellscreen as claimed in claim 1, 2 or 3, wherein the base pipe has an outer surface having a plurality of rods disposed longitudinally thereon.

5. A wellscreen as claimed in any preceding claim, wherein the outer wrap has an inner surface having a plurality of rods disposed longitudinally thereon.

6. A wellscreen as claimed in any preceding claim, wherein the inner and outer wraps are selected from a group of metal wire, sintered fibres, ceramic materials, woven polymer fabrics, Dutch twill weaves and a combination thereof.

7. A wellscreen as claimed in any preceding claim, whereby the wellscreen can withstand hydrostatic pressures from about 2500 p.s.i. (17.2 MPa) to about 3500 p.s.i. (24.1 MPa).

8. A filter for use in water wells, the filter comprising:
a perforated base pipe for disposal on a tubular string;
an annular area formed between the base pipe and a the tubular coaxially disposed therearound; and

a layer of filtering material disposed in the annular area.

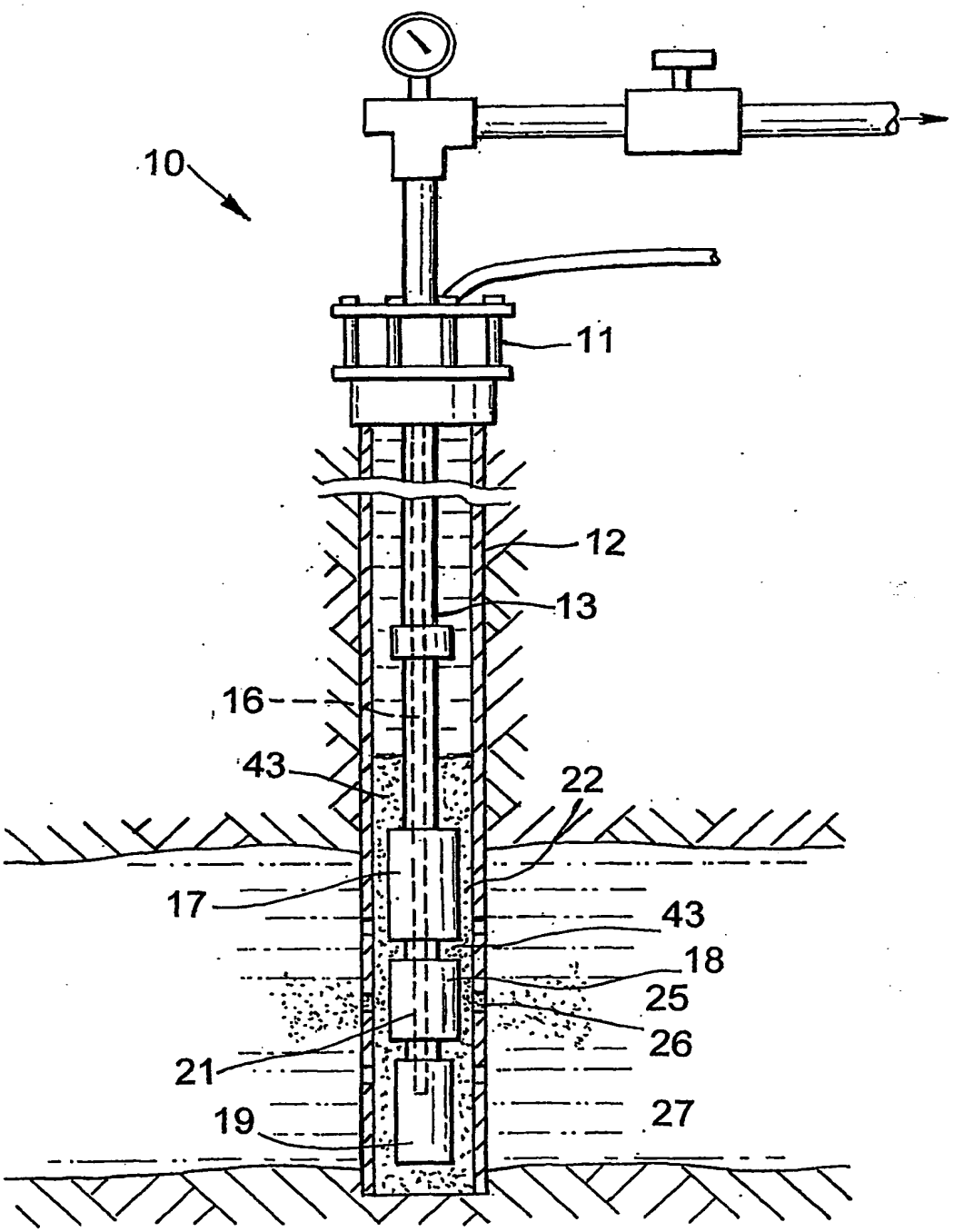

Fig.1
(PRIOR ART)

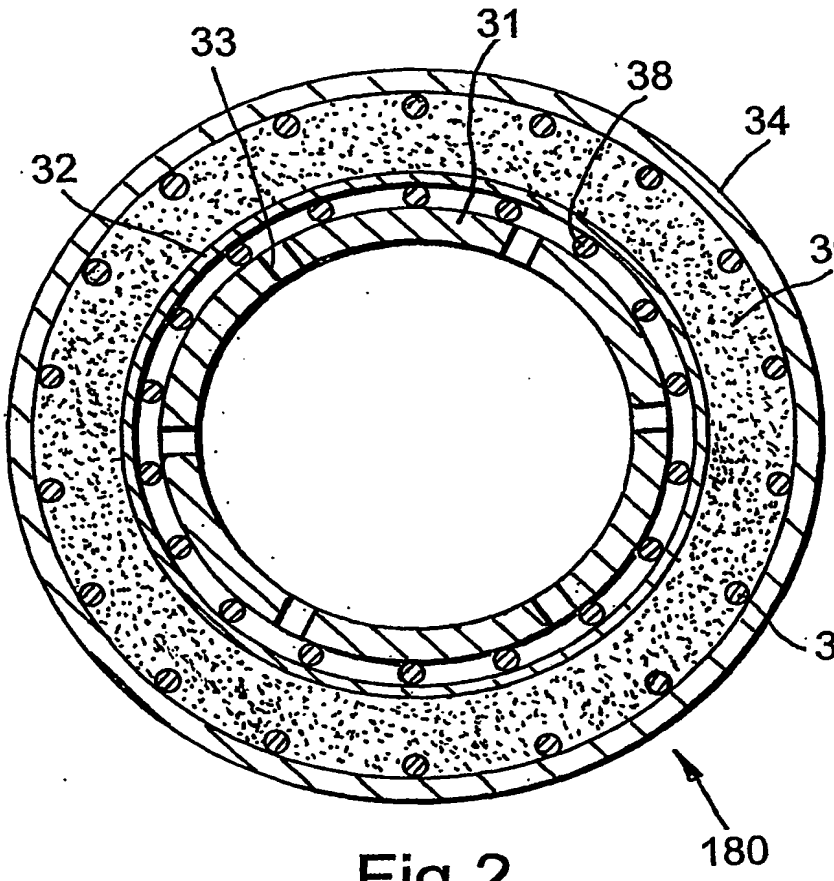

Fig.2

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 E21B43/08 E03B3/26 B01D29/15

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 E21B E03B B01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 004 049 A (ARTERBURY) 2 April 1991 (1991-04-02) claim 6 column 2, line 62 column 5, line 20 - line 26	1-6
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X	US 4 014 387 A (FINK) 29 March 1977 (1977-03-29) column 2, line 57 - line 61	8

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 March 2002	05/04/2002

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Sogno, M

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INTERNATIONAL SEARCH REPORT

rmation on patent family members

Interr I Application No
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International Application No
PCT/GB 01/04937

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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